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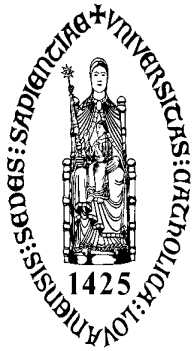

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Regulations, brokers, and interlinkages: The institutional organization of wholesale markets in India

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Abstract: *There is a vigorous debate on the liberalization of heavily regulated agricultural markets in India. A crucial institutional characteristic is the role of state regulated brokers in wholesale markets. Relying on data from a unique survey in Uttarakhand, a state in North-India, we find that regulations on margins are ineffective as most brokers charge rates that significantly exceed the regulated ones. We also find that a majority of farmers self-select into long-term relationships with brokers. These relationships allow some of the farmers to interlink credit and insurance markets to the agricultural output market. This interlinkage does however not appear to be an instrument for farmer exploitation (as it does not lead to worse inputs, high interest rates, or lower implicit output prices), but is seemingly an extra service by brokers as to establish farmer loyalty to him and thus to ensure future supplies.*

JEL classification: Q12, Q13, L15

Keywords: India, agricultural marketing, brokers, interlinkages

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1. Introduction

Since the end of the 1990s, India's economy has grown by impressive numbers. It is generally accepted that growth was triggered and sustained by a series of gradual steps at liberalizing India's regulated economy. Despite the observed success of liberalization in promoting growth, the debate on liberalization versus regulation is far from over, in particular when it concerns the more traditional economic sectors in India. One of these is agriculture. Government intervention has been pervasive in agricultural markets in India since independence in 1947. Until very recently, almost all of India's wholesale markets were in some way regulated (Acharya, 2004). Regulations included a variety of rules such as a licensing system for traders and brokers, the imposition of auctions, the requirement for buyers and sellers to go through government-licensed brokers, the size of commission rates, mandated weighing charges and costs of loading and unloading, and taxation of each transaction. These regulations were imposed decades ago. Their purpose was to improve the efficiency of markets and to ensure remunerative prices for producers as well as affordable prices for consumers as agricultural marketing was then perceived to be badly organized, leading to low prices for the producer, large physical losses, and high marketing costs (Mehta, 2006; World Bank, 2007; Acharya, 2004).

However, current market realities do not meet these objectives. Recent research on the traditional marketing system in India concludes that agricultural markets are not efficient (Mattoo *et al.*, 2007; Umali-Deininger and Deininger, 2001), lack integration (Palaskas and Harriss-White, 1996), are pested by collusion (Banerji and Meenakshi, 2004), and are characterized by a high level of wastage (Mattoo *et al.*, 2007). In response to these failures, the central government has proposed a set of reforms in 2003 to liberalize the regulated system. This has sparked an active debate on the vices and virtues of existing market regulations (e.g. Shiva, 2007; Gopalakrishnan and Sreenivasa, 2009). State governments have shown mixed reactions. Some have undertaken liberalization, others have continued the existing regulations.

It is now well known that the impact of liberalization of highly regulated food systems is crucially dependent on the institutional organization of the regulated system, on external conditions, on the nature of the liberalization process – as is well documented by the very diverse experiences in agricultural liberalizations in East Asia, compared with those in Africa, Eastern Europe and the former Soviet Union (e.g. Rozelle and Swinnen, 2004; Swinnen *et al.*, 2011). It is therefore crucial to have a good understanding of the precise

empirical functioning of the regulated systems to assess how (various forms of) liberalization would affect this.

Interestingly, despite the vigorous debate on the pros and cons of market regulations in India, surprisingly little empirical research has been done recently on the functioning of these markets and on the effects of these regulations, as to inform the public debate (notable exceptions are e.g. Goyal, 2010; Banerji and Meenakshi, 2004, 2008). This paper aims to contribute to reducing this information gap. We study some key institutional aspects of traditional regulated markets and their effects. In particular, we focus on the central role played by state regulated commission agents, so-called "brokers": agents who are widely present in Indian markets to assist sellers in finding buyers through the organization of auctions. It is mandatory for buyers and sellers of food to work through brokers, whose activities are licensed, and whose fees are fixed, all as part of the extensive government regulation of market transactions.

In this paper, we use micro-economic evidence to analyze the functioning of these agents in their regulated environments. Based on primary data from wholesale markets in the northern state of Uttarakhand, we look specifically at the important role of the broker in horticultural market transactions. The contributions of our research are twofold. First, we rely on a unique survey design. We collected data from farmers, i.e. the sellers, and retailers, i.e. the buyers, that just completed a transaction on the wholesale market. Through their answers, we are able to piece together information on effective practices of brokers, beyond information they revealed themselves. The results show that regulations on prices and prescribed commission rates charged by brokers in these markets are largely ineffective. This is an important finding as there is an active debate in the country where some people argue for the importance of further regulation of wholesale markets (e.g. Shiva, 2007; Gopalakrishnan and Sreenivasa, 2009). These proponents assume that the regulations deliver in practice what they state to deliver in theory.

Second, as we did not only collect information on broker practices in agricultural output markets but also on markets for credit and insurance, we are able to link broker activities to services delivered in these interlinked markets. There is a vast literature on interlinking and it has been argued that such interlinkage often leads to exploitation of farmers (e.g. Crow and Murshid, 1994; Basu, 1986; Bell, 1988). We find, consistent with the previous literature on interlinkages (Bell, 1988; Basu, 1986), that brokers subsidize interest rates on advances but in contrast with this literature, we do not find that this leads to lower

implicit output prices. Brokers thus seem to use these interlinkages as to tie the output of the farmers to them and they seem to have enough rents under the existing regulated market system to pay for the costs of the financial services they provide.

This paper is structured as follows. Section 2 gives background information on the functioning of agricultural markets in India. In Section 3, our data and methodology are presented. In Section 4, we discuss some descriptive statistics on the nature of transactions on these wholesale markets. Section 5 looks into the effects of market regulations. Section 6 studies the role of relationships and market interlinkages. We finish with the conclusions and implications in Section 7.

2. Wholesale markets, brokers and regulations in India

Government intervention in agricultural markets has been pervasive since India's independence in 1947, with the initial objective of improving the efficiency of markets, ensuring remunerative prices for producers as well as affordable prices for consumers (Mehta, 2006: 146; World Bank, 2007). At that time, agricultural marketing was perceived to be badly organized, leading to low prices for the producer, large physical losses, and high marketing costs. A large number of regulations were thus put in place—including controls on private storage, transport, processing, exports, imports, credit access, and market infrastructure development, as well as a small-scale reservation policy for selected industrial sectors.

One of the main interventions by the government was to establish a large number of public market yards for the wholesale of agricultural products and to regulate these markets through an Agricultural Produce Marketing (APM) Act (Acharya, 2004).[3] Wholesale markets (*mandis*) numbered 268 at Independence. It is estimated that there were around 6,300 wholesale markets in India in 2007 (Chauhan, 2008). Agricultural marketing within a particular state is regulated by the local Agricultural Produce Marketing (APM) Act but variation exists between the states in terms of the extent to which the act is implemented. If it is implemented, an Agricultural Produce Marketing Committee (APMC) is responsible for enforcing the act for each market area. The APMC is empowered to establish markets,

[3] The wholesale market (*mandi)* premises are known as the "market yard". This must be distinguished from the "*mandi* area", which is the entire territory under the purview of a particular *mandi*. This means e.g. that all the *mandi* tax chargeable to the agricultural output produced in the area must be paid to that particular *mandi*, even if it is not physically traded within its premises.

control and regulate the admission of traders to the market, charge fees (market, license, and rental fees), issue and renew licenses, and suspend or cancel licenses. It allots shops to agents who meet basic eligibility criteria (based on nationality, solvency, and other not particularly restrictive criteria) upon payment of a (rather small) license fee.[4] Once awarded, licenses can be renewed annually.

The salient feature of a typical (non-amended) APM Act is that all "notified" agricultural commodities grown in the "notified" area of the market (encompassing its legally defined primary catchment area) are required by law to be sold only on these markets, and exclusively through government-licensed traders or brokers, usually through auctions.[5] In other words, in the traditional APM Act, there are no provisions for direct procurement from the farmers' fields, nor for contract farming. There are clear upper bounds to the commission rates brokers are allowed to charge; and brokers must pay taxes to the *mandi* authorities as a contribution to a marketing development fund. This fund should be used for e.g. developing infrastructure at wholesale markets and their "notified" area.

Typically, farmers bring their produce to the wholesale market and to the shop of the broker with whom they would like to work. Buyers—mostly retailers—then pick up the produce from there. Transactions take place mostly by means of an open-outcry auction, managed by a broker who does not take possession but rather just takes commission (therefore called a "commission agent").[6] As lots are auctioned, new prices are set. Sub-wholesalers, who buy on the wholesale markets but do not sell to consumers themselves, or (petty) retailers, who do sell directly to consumers, buy produce on these wholesale markets. The latter then distribute these products by pushcarts, in mom-and-pop stores, or at wet markets to urban consumers (see also Minten *et al*., 2010).

Under the APMC marketing system, it seems that the bulk of trade in agricultural commodities takes place at the wholesale market, run and operated by the APMC. While farmers might have the option—depending on state regulations and on the enforcement of

[4] The procedures for licensing are the following: Commission agents pay every year 250 Rs for their license, plus 1 Rs "form fee". This seems to be a nominal amount. These licenses can be renewed on a yearly (or a 5-year) basis and it happens very rarely that licenses are not being renewed (but they can be transferred to other family members). There is no restriction on the total number of licenses that can be given out. Every year there are new applications for as well as issues of licenses. So, there are seemingly few barriers to entry.

[5] The number of notified commodities varies by state and market location, but in general all major food commodities are included.

[6] Unfortunately, no statistics exist on either their geographic coverage or the percentage of crops they handle compared to the trader who takes possession.

these regulations—to go through local village traders,[7] Fafchamps *et al.* (2008) find that the majority of non-staple foods is sold directly through brokers on the wholesale markets by the rural producers themselves.

It has been acknowledged in the literature that these regulated markets have served farmers well over time, by offering an assured market and reducing exploitation by unscrupulous traders (Kahlon and George, 1985:26), that these markets have successfully become a nodal point in agricultural marketing in India as the majority of marketed produce passes through it (Fafchamps *et al.*, 2007), and that they have created growth centers influencing employment, industries and land use in their proximity (Harris, 1974). However, the regulated market system has come under increased criticism over the years.

One reason is the perception of low prices received by farmers compared to consumer prices (e.g. Prashant, 2010), which may be partly attributable to collusion by brokers and the perceived lack of other sales outlets for small farmers (Goyal, 2010). This basically stems from the fact that the APM Act prohibits farmers from selling outside the market yard. While in theory there is no limit on the number of licenses issued by the APMC, the number of license holders typically greatly exceeds the number of shops available in the market yard. Legally, license holders have equal right to conduct business, but in practice the lack of space for trading often severely curtails their business. Since the number of physical shops is practically fixed and holders rarely return licenses, the advantage enjoyed by license holders who have secured a shop at a given rate generally only reinforced over time. Invariably, members of the same family conduct business at the same shop, which is passed on from one generation to the next.

A second factor putting pressure on traditional market regulations is the increased demand for food safety and quality driven by strong income growth and development. Effective quality management requires the establishment of closer relationships between upstream and downstream agents, leading to increased vertical coordination in modern supply chains (Swinnen, 2007). As APMCs have emerged over time as a government-sponsored marketing-services monopoly that prohibits innovations such as contract farming and the direct procurement of large corporate bodies (Acharya, 2004), in many states closer vertical coordination in agricultural supply chains is ruled out by law.

[7] These village traders may be either independent or work for specific brokers in the wholesale markets.

A third problem is the increased importance of bureaucrats in the management of the APMCs: although more than half the members of this committee were representing the farmers of the market area at the start of the regulated market system, elections have not been held regularly, and committees are now often administered by bureaucrats, possibly stifling private sector investments (Acharya, 2004).

Further problematic aspects include the large area served per market yard, the creation of barriers to entry for newcomers, and the overreliance on market fees as a source of income for the government (Archarya, 2004). While the APMC collects significant revenues from market fees, the infrastructure in most markets is largely deficient, as revenues are often directed towards other ends by the government (Umali-Deininger and Sur, 2007; Fafchamps *et al.*, 2008). As a result, the majority of wholesale markets are not paved, and there are few grading or cold storage facilities. Sanitation facilities are largely deficient, with few public toilets, inadequate drainage, and little or no coordinated pest control.[8] As can be expected, postharvest losses are rather large in this trading environment.

Given these perceived problems with the existing regulated agricultural market system as well as the eagerness to seize new opportunities for agricultural development, the central government, in consultation with state governments and the private sector, formulated a Model Amended Act, which was circulated to the states in 2003. The Model Amended Act proposed the removal of restrictions on farmer direct marketing, the opening of market infrastructure development to other agencies (especially the private sector), and the establishment of a framework to support contract farming. Indian states have responded differently to the Central Government's initiative. By early 2007, 11 of the 28 states in India had amended their APM Act but 14 had not, while 2 had never had the original act in place and 1 (Bihar) repealed the act (Chauhan, 2008).

3. Data and methodology

To better understand the activities on traditional regulated wholesale markets for horticultural products, a survey was conducted in Uttarakhand, a state in the North of India.[9] There are 17

[8] To understand why this is important, see e.g. Shilpi and Umali-Deininger (2008) for empirical evidence on the benefits of market infrastructure for agricultural trading in Tamil Nadu.

[9] Uttarakhand was established as an independent state as recently as in 2000. Uttarakhand's population is estimated at 8,489,000 (Census of India, 2001), of which 74% lives in rural areas. It is estimated that 90% of the population depends on agriculture for its living (Government of India, 2010). Major agricultural crops include rice, potato, wheat, peas, litchi, apple, green gram, and medicinal plants (Government of India, 2004).

wholesale markets in Uttarakhand, out of which 16 are regulated under the APM Act and only 1 is non-regulated. While a draft bill on the amendment of the APM Act in the state was in circulation at the time of the survey (and had been for a number of years), it had however not yet been voted on by the Uttarakhand Assembly. The survey was conducted in December 2007 on the two major wholesale markets of Uttarakhand, the wholesale market of Dehradun (*Niranganpur*) and the wholesale market of Haldwani (*Naveen Mandi Sthal*). According to the Government of India (2004), the main crops arriving to the Dehradun wholesale market are potatoes, green peas, ginger, and litchi. The main crops arriving to the Haldwani wholesale market are potatoes, tomatoes, wheat, and rice. In the year 2007, the Dehradun market had 13 category A broker shops, 34 shops of category B, 78 of category C, 56 of category D, 10 of category E and a small number of brokers operating out of tin sheds.[10] The Haldwani market had about 230 shops of categories A, B and C, and another 20 or so brokers operating out of tin sheds. Brokers pay a low yearly license fee of 250 Rs (around 6 USD). They may as well apply for a 5-year license.

Our survey focuses on the vegetables cauliflower and green peas. These were the two vegetables that were in full harvesting season and in plentiful supply at both wholesale markets under consideration during the weeks in which our survey was conducted. They are both produced locally and both crops are characterized by significant seasonality. For instance, *mandi* records on the year preceding the survey show that average prices in the period December-March were only one-third the level of the lean period (June until September). Supplies on wholesale markets show even larger swings over the year. The Indian government does not directly intervene in the procurement or price setting of horticultural crops.

Our preliminary interviews and data collection revealed that there were major discrepancies between information on transactions collected directly from brokers and the agents they interacted with. It became clear that because of existing regulations, brokers had strong incentives to misrepresent information on transactions. Hence, one could not rely on interviews with brokers as reliable sources of information. It was thus decided to interview farmers and petty retailers (the major buyers on these markets) that just completed a transaction on the wholesale market and to piece together the functioning of brokers based on

[10] These shop categories are based on size (and correlated with the brokers' sales volume); the yearly shop rent is fixed per category.

farmer and retailer interviews. We did not find incentives for these agents to systematically bias information, in contrast with brokers. Hence, we believe that we obtained a more truthful picture this way.

A total of 480 questionnaires were completed of which 240 in Haldwani and 240 in Dehradun. The study was set up in such a way that half of the surveys were conducted with farmers and half of them with retailers and that half of the agents were involved in green peas and half of them in cauliflower. Farmers and retailers were both randomly selected. Farmers were interviewed on the wholesale market, right after selling their produce, while retailers were interviewed at the major retail markets of the city.[11] Enumerators were explicitly asked to behave in a discrete way, as to avoid being obstructed by suspicious brokers.

The survey contained detailed questions on the demographic background of the interviewees, the reasons for the choice of the marketing channel and the broker, and on linkages with the broker used in the last transaction of cauliflower or green peas. Then, information was asked on the last completed transaction, including detailed and disaggregated information on prices and costs, observable quality characteristics of the product, quality and quantity assessments by retailers, and the costs incurred in the last transaction. The survey finished with questions on wholesale market practices in general.

We start with descriptive statistics on the farmers and retailers who participated in the survey (Table 1). There is little difference with respect to demographics between farmers and retailers. While farmers are slightly older (47 years versus 37 years for retailers), the level of education and the size of the households are similar. About 40% of them are member of a disadvantaged group under the Indian system, i.e. a scheduled caste, tribe, or other backward caste. 29% of the farmers carry a BPL (Below the Poverty Line) and 65% an APL (Above the Poverty Line) card.[12] This compares to 30% and 51% respectively for retailers. On the other hand, while 47% of the farmers own a mobile phone, only 25% of the retailers have one.

Apart from green peas and cauliflower, the majority of farmers and retailers also sell other agricultural products. 83% of the farmers sold other products over the year and 85% of the retailers sold another product over the last two weeks. The two products are however of

[11] This was considered to be the optimal way to get as reliable as possible information from both groups of respondents. Retailers, who would visit the wholesale markets in the morning, were often under time pressure to leave the wholesale markets and start their retail activities. In the afternoon, they typically had more time available.

[12] Both BPL and APL cards are distributed to poorer households by the government as to allow them cheaper access to basic necessities.

major importance for these agents. They make up 75% of the annual monetary income of farmers and represent 41% of the turnover of retailers over the last two weeks. Both have similar years of experience in dealing with the product under study. As could be expected, farmers and retailers differ in the frequency of market visits. Retailers visit almost every day while farmers come on average 23 times a year. Few farmers (16%) and retailers (2%) visit other markets.

4. The nature of transacting

We distinguish four operations in an agricultural marketing transaction on the wholesale market: physical handling, quality assessments, quantity assessments, and financial settlements. They are discussed consecutively.

(a) Physical handling

The farmers face physical handling and transaction costs in the process of selling their produce to the wholesale market. First, farmers transport their produce to the market and bear the costs for this. The large majority of farmers (94%) use motorized transport to do so. Little aggregation and pooling takes place at the village level as 62% of the farmers only bring produce of themselves when they travel to the market. Except for those farmers who own their own means of transport, transport usually has to be paid for and amounts, on average, to almost 10% of the price that is fetched on the wholesale market. Second, farmers face opportunity costs for this physical handling process as well as for assisting at the auction. The average farmer spends almost two hours to travel to the market and another two hours to go back as well as 3.5 hours on the wholesale market itself.[13] In total, an average farmer reports to spend 7.5 hours to conduct an agricultural transaction, which is valued on average at about 75$.

(b) Quality assessments

The large majority of retailers believe there are quality differences between the different lots of agricultural produce at the wholesale market (Table 2). To assess the quality, retailers rely mostly (85%) on personal inspection. 10% of the retailers report to trust the broker in offering

[13] Some of the time spent on the market might not be used towards transactions but more towards social interactions that might not be of direct use for the transactions.

quality; the remaining 5% claim to have no assurance on the quality on offer. In case of personal inspection, quality was checked mostly by looking at and touching the produce. One third of the retailers reported to even have tasted the produce. While only part of the produce could be checked in most transactions, almost all retailers believed that the checked sample was representative.

While modern markets and especially international markets put a high premium on food safety, this seems to be less the case in these traditional horticultural markets. The use of modern inputs is high in horticultural production in India but the current marketing system does not allow for transmission of information on the use of inputs (Fafchamps *et al.*, 2008) – even if there might be important public health issues related to the lack of proper attention and effective food safety standards (Umali-Deininger and Sur, 2007).[14] In our sample, only one fifth of the retailers stated that they were aware of the farmers' cropping practices and use of pesticide, fertilizer, and irrigation water. However, even if retailers are aware, this does not preclude the sales of unsafe food. Recent research in India shows that in traditional markets there is no price premium attached to these unobservable quality characteristics (Fafchamps *et al.*, 2008).

(c) Quantity assessments

80% of the farmers and 73% of the retailers say that they know the exact weight of the lot, as the produce they are selling or buying has been weighed in front of them (Table 2). Weighing methods are mostly old-fashioned as only for about one-third of the weighing transactions an electronic scale is used. When lots are weighed, in many cases weights are rounded to the nearest kg. This practice is mentioned by 88% of the farmers and 86% of the retailers. The advantage from rounding off weights is in most cases towards the broker or the retailer.

The lots that are auctioned might contain waste, such as rotten produce or foreign matter. For the retailers to correctly valuate lots before doing a bid, they should be well-informed on wastage levels. If not, retailers might charge uncertainty premiums that are passed through to the farmers. About one third of the retailers state they do not know very

[14] For example, Marshall *et al.* (2003) tested fresh vegetables in different production sites and in the main wholesale market in Delhi. They found that 72% of the spinach samples exceeded the Indian Maximum Residue Levels (MRL) and 100% exceeded the Codex MRL level. Kumari *et al.* (2004) found that 26% of their samples of seasonal vegetables contained residues above the MRL levels.

well the level of wastage of the lot that they will purchase. 9% says that they do know it exactly while the majority (57%) claims to know it approximately (Table 2).

Overall, the large majority (78%) of the retailers reports to be satisfied with the quantity assessment. However, there is still some dissatisfaction with the existing system as illustrated by the asymmetric responses by farmers and retailers towards rewards and payments for quality and quantity. About two-thirds of the farmers believe that they sometimes deliver higher quality and quantity than they are paid for while one quarter or less believes that they deliver lower quality and quantity than paid for (Table 2). The complaints are similar, but in the opposite direction, for retailers.

(d) Financial settlements

Payments for the transactions are in most cases immediate and in cash for farmers as well as for retailers. 82% of the interviewed farmers state that they are paid within three hours after the transaction. The large majority of retailers also report to pay immediately for the transaction. Agricultural trading is largely a cash economy as almost none of the transactions are settled by check or other more sophisticated means of payment. Similar results on the importance of unsophisticated and cash transactions have also been found in other developing agricultural economies (Fafchamps, 2004; Fafchamps and Minten, 1999; McMillan, 2002).

In summary, it seems that most transactions on these wholesale markets are small cash-and-carry transactions with significant transaction costs, as physical handling, quality and quantity assessments, and financial settlements are all combined in a single transaction. Fafchamps and Minten (1999) argue that this is usually not an efficient way of conducting trade given that search costs are significantly higher than they should be and large amounts of cash circulate in the countryside, creating problems of insecurity as well as of an inflation tax. Along the same lines, Reardon *et al.* (2003) argue that the separation of the different processes of physical handling, quality and quantity assessments, and financial settlements in developing countries' agricultural markets would often be paramount to achieve greater efficiency through economies of scale.[15]

[15] For example, the large horticulture cooperative Safal has about 300 retail booths in New Delhi and a procurement system which has served as a model for different modern retailers in India. It organizes procurement through collection centers in the village, outsources transportation services, relies on farmers' associations to assess quality and quantity and pays through bank wires.

5. The effect of regulations

An important regulation of the Agricultural Produce Marketing (APM) Act in vogue in Uttarakhand states that the broker rates should not be higher than 3% and that 2.5% tax on each transaction is to be paid by the broker to the market officials. Both these charges are stated *not* to be paid by the farmer. We test with the data that were collected from farmers and retailers to what extent these regulations are respected. Figures 1 and 2 show the net prices that farmers received and that retailers paid for the two products under study.[16] First, they illustrate the large price variation for these products over the time of the survey, often due to location, quality differences, and the day of the transaction. Second, they show the clear parallel leftward shift of the net price received by the farmer compared to the price paid by the retailer, reflecting the wholesale market costs and rents.

These figures, of course, are merely suggestive. To get a more accurate estimate of these costs, we should control for several factors that might influence prices (P) faced by different agents (farmers versus retailers) in the market. To do so, we estimate two empirical models. First, we run a parsimonious specification:

$$log(P) = \alpha_0 + \alpha_1 L + \alpha_2 A + \varepsilon$$

where L is defined as the wholesale market location, A is a dummy taking the value 1 for retailers, and ε is the error term. We then add in a second specification additional controls such as quality characteristics of the product (Q_k) and the time of sales (S_l):

$$log(P) = \alpha_0 + \alpha_1 L + \alpha_2 A + \Sigma_{kk} \alpha_{3k} Q_k + \Sigma_l \alpha_{4l} S_l + \varepsilon$$

For both specifications, we test the hypothesis H_0: the size of the margin measured by $\alpha_2 > 5.5$. A rejection of this hypothesis would indicate that the marketing regulations are not respected. It is important to note that, due to the specific organization of transactions at the wholesale market, we were not able to establish exact matches between farmers and retailers for the same lot being transacted. However, because of our specific sample set-up and the

[16] Small business owners often over-report expenses and underreport revenues. We have tried to minimize this bias by surveying farmers and retailers right after their last transaction; and we have tried to be as specific as possible in formulating our questions. All this information was used to calculate 'net' prices, defined as the total amount that farmers would take home and that the retailer would have paid after leaving the *mandi*. We have asked the exact volume transacted, the gross value (farmers could choose whether to specify this for total volume, per bag of produce, or per kg of produce), and all the costs faced (disaggregated) at the *mandi*. The transportation costs were asked for separately as a cost not faced on the *mandi* (and not integrated in the 'net' price calculations). In the majority of cases, retailers did not face transportation costs as they typically would come to the wholesale markets with their own pushcart early in the morning, fill up the cart with merchandise, and then take it to the area where they would sell the produce. Enumerators were trained for several days to make sure that the concept of 'net' and 'gross' were well understood and implemented.

collection of relevant controls, we believe that the estimated regression model does capture the appropriate aggregate margin averaged over the period of our survey.

The results of the parsimonious regressions are shown in Table 3 (Model 1). They indicate that the (net) price paid by retailers is significantly higher than the (net) price received by farmers for both cauliflower and green peas. The difference is as high as 13% in the case of green peas and 26% in the case of cauliflower. As price differences could be caused by other factors such as the quality of the product as well as the day of the transaction, we next add these additional controls in the second specification of the regression (Table 3, Model 2). The coefficients stay largely significant and the size of the coefficient is robust.

The estimated price gap between farmers and retailers is significantly higher (as confirmed by the F-statistic reported at the bottom of Table 3) than the 5.5% (3% commission rate and 2.5% tax) which one would expect it to be if the wholesale market worked as prescribed by the regulations. As we interviewed only farmers and retailers that had a transaction on the wholesale market, the results thus support the view that marketing regulations on margins are not respected.

The difference that we find even exceeds the gap that was predicted by key informant interviews. One of the key informants that we talked to at the Dehradun horticultural *mandi* claimed there is a general agreement amongst brokers of his union to charge 6% commission to sellers (farmers) and 6% to buyers (retailers), including *mandi* taxes. The corresponding agreement in Haldwani was to charge 8% commission to farmers. Such agreements were clearly in violation of APMC rules. We also interviewed several APMC officials as to hear their side of the story. After some probing, APMC officials admitted that brokers were charging rates beyond legal limits; and that brokers would underdeclare their effective turnover in order to avoid taxes. However, not much seemed to be done about this as the lobby of brokers was said to have powerful connections with the government and that brokers were reported to fund electoral campaigns. Obviously, these latter statements were difficult to verify in practice.

6. Relationships with brokers and market interlinkages

6.1. The type of relationships with brokers

While there are only a few marketing options for the surveyed farmers and retailers outside the broker channel (partly due to market regulations), there seems to be a large set of options within this channel. Farmers state they can choose among 60 brokers dealing in the produce

they are selling. Of these brokers, they state to know five personally. However, in practice farmers only use a limited number of brokers for their transactions, i.e. less than 2 on average (Table 4). 57% of the farmers only used one broker for all their transactions of a particular product last year (on average 26 transactions in total). A significant number of farmers thus self-select in a specific broker relationship. Often they have a long-term relationship with this broker as they report to have dealt with the broker of the last transaction on average for almost 10 years.[17] This suggests that traditional Indian wholesale markets have not yet moved from the traditional type of market exchange, which is personalized and relationship-based, to the modern type of market exchange which is rules-based and anonymous (North, 1990:83).

An obvious question is then why these farmers self-select into long-term relationships. Different reasons have been given in the literature on the benefits of "cooperative relationships" in this type of trading environment (e.g. Kranton, 1996; Fafchamps and Minten, 1999; 2002). They include among others information sharing, regularity of supply and demand, access to credit, prevention of contractual breach, and risk sharing.

In earlier (e.g. Bell, 1990) as well as in more recent literature (e.g. Reardon *et al.*, 2008) on Indian agricultural markets, it has been suggested that financial interlinkages between farmers and brokers on traditional markets have been a major reason for resilience of traditional markets and the perceived difficulty of modern channels to compete with traditional ones. In this literature, it is argued that long-term relationships with brokers are especially valuable for access to credit and insurance.

Access to seasonal credit for agricultural producers is often problematic for the poorest farmers all over the developing world, mostly due to seasonal liquidity constraints (Dercon and Christiaensen, 2007). Furthermore, a common problem for rural agricultural economies is the prevalence of different types of shocks for which especially poorer households might be ill-prepared. Given the lack of formal insurance mechanisms, households must often rely on social capital and sales of assets to deal with shocks and only those households that have access to informal insurance mechanisms are able to successfully smooth their consumption (e.g. Rosenzweig and Wolpin, 1993). Hence, if there are important imperfections in rural credit and insurance markets, the opportunity to establish market

[17] Retailers report a similar large number of brokers to choose from but they usually consider a larger number than farmers that they effectively use for transactions.

interlinkages seems to be a plausible reason for establishing personalized relationships with brokers – as it gives farmers (and possibly petty retailers) access to informal credit and insurance markets.

While there is ample evidence in the academic literature on the existence of these interlinkages (Hoff and Stiglitz, 1990; Bell *et al.*, 1997), it is less clear which role they play in the establishment of long-term relationships with brokers. This is one aspect we will document in this section. Moreover, there has been a lot of interest in the literature with respect to the nature of these interlinkages. In particular, it has often been argued that such interlinkage might lead to exploitation of farmers (e.g. Crow and Murshid, 1994; Basu, 1986; Bell, 1988).[18] To further complement the existing literature, which mostly focuses on interlinkages between farmers and brokers, we also investigate whether there are similar links between petty retailers and brokers.

Our data show that some farmers — and a limited number of retailers – indeed use the broker as a source of credit and/or insurance (Table 5). 39% of the farmers report that in case of need, the broker would grant them a loan "for sure". 18% of the farmers think that he would "probably" do so. While more than half of the farmers think that they could rely on the broker in case of need, only 22% of the farmers have ever received a loan from the broker they dealt with in the last transaction. 20% of the farmers received a loan in the last 5 years.[19] However, farmers seldom rely exclusively on brokers for access to credit as 96% of the farmers report to have alternative sources of credit. These include formal banks (for 46% of the farmers) but more importantly friends and family (78%). In addition, 21% of the farmers received this year an input advance from the broker they dealt with in the last transaction. For half of the farmers, this advance was in kind, more specifically in the form of seeds.[20] Hence, it seems that interlinkages are prevalent in these agricultural markets, and even if there is a minority of farmers effectively using them for access to credit and/or insurance, many more report they could use them if they wanted.[21]

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[18] However, this does not have to be the case and they can even be beneficial as shown in other continents and settings by Dries and Swinnen, 2004; Gow and Swinnen, 2001; Minten *et al.*, 2009; Maertens and Swinnen, 2009.

[19] The average value of the loan was 8,263 Rs (more than 200$) or about twice to four times the value of the last transaction.

[20] No fertilizer or pesticides were given in kind to any farmer in our sample. There are a few farmers receiving advances partly in cash and partly in kind.

[21] This has also found by other authors. For example, Bell (1990:306) reports that: "Traders and commission agents (who operate as brokers between farmers and both private traders and state purchasing agencies) are

Interestingly, access to credit through brokers is practically insignificant for retailers. Only 7% of the retailers believe that the broker would give loans "for sure" in case of need and only 2% of the retailers report to ever have received a loan from a broker. Moreover, 95% of the retailers claim to have other options for access to credit. Nevertheless, also retailers typically self-select into long-term relationships with brokers, and they do so nearly as much as farmers: retailers report to have transacted with the same broker for on average 9.2 years (compared to 9.7 years for farmers). While they typically interact with a larger number of brokers than farmers (on average 3.5 in the last two weeks), this could be due to the fact that brokers are specializing in certain products, while most retailers have a large variety of products on offer.

When farmers and retailers are explicitly asked why they chose the specific broker in their last transaction, surprisingly few respondents however list these financial services as a major reason. In practice, access to credit and insurance lag behind all other options given (Table 4). Only 26% (resp. 21%) of the farmers list the provision of input advances (resp. the provision of loans for other purposes) as an important reason for selecting a broker. Our earlier finding on the insignificance of interlinking for retailers is once again confirmed: only 4% of the retailers would choose a particular broker because of the financial services he provides. Overall, it seems interlinkages are less important in explaining repeated exchange and personalized relationships than has been assumed in the literature.

Sharing information also does not perform well in explaining long-term relationships with brokers. Wholesale horticultural transactions are spot transactions where farmers and retailers show up without much prior contacts. 95% and 98% of the farmers and retailers respectively reported that they had no contact with the broker before coming to the market. For those that had contact, only a limited number discussed prices with the broker. Most of the price information for farmers and retailers was obtained informally through personal observation or through contacts with fellow farmers or retailers.

While a seemingly non-economic reason such as habit formation is part of the explanation of going through a specific broker (50% and 29% of farmers and retailers respectively state this to be very important), most farmers and retailers state that the decision is mostly based on a perceived reduction of search costs and on obtaining the best price

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often heavily involved in financing cultivation, with the provision that their clients sell their crops to, or through them, respectively."

possible. This is in line with the argument made by Fafchamps (2004) that "repeated exchange can be seen as a way of economizing on the costs of establishing personal trust" and anecdotal evidence from our survey that "new" farmers were charged higher commission rates. The importance of trust in the relationship between farmers and brokers is also reflected in the trust-related data coming out of our data. While only 52% of farmers reports to trust most *mandi* officials, up to 95% of the farmers in our sample report to trust most brokers. This corresponds to 49% and 95% for retailers, respectively.

6.2. The nature of interlinkages

Next, we turn to a more detailed description of the nature of interlinkages observed at the wholesale markets under study. There is a vast literature on interlinking markets. Seminal work by Bell (1988) and Basu (1986) indicates that a principal can extract more profit by interlinking markets. Typically, credit markets are interlinked with land, labour, output or input markets, and below-market interest rates lead to higher productivity and hence higher gains in the linked markets − be it the land, the labour, the output or the input market − where above-market rates can be charged by the lender or below-market rates paid to the borrower. However, it has also been argued that such interlinkage might lead to exploitation of farmers (e.g. Crow and Murshid, 1994; Rao and Jeromi, 2006).

In a different strand of literature, Bardhan *et al.* (2009) argue that intermediary traders play crucial roles in marketing and financing activities all over the developing world and that this constitutes a source of rent creation. In their view, these "entrepreneurial rents" are a result of their access to cheaper credit (or in our context possibly also better inputs) in a world with credit market imperfections, as well as of reputational advantages they may enjoy vis-à-vis other traders.

To corroborate these arguments, we explore different aspects of these interlinkages coming out of our data. First, we analyze the determinants of market linkages. Knowledge of who is more likely to use these financial services (and to which extent) may already give us some insights in their potentially exploitative nature. In particular, rent extraction would be more likely to occur in case of bargaining power imbalances between the farmer and the broker. Viewed from this perspective, if poor farmers (who can be assumed to be more vulnerable) are disproportionately involved in interlinkages, this may be a reason for

concern.[22] Next, we verify whether interlinkages result in high interest rates on advances as well as in below-market output prices.

(a) Determinants of interlinkages

To empirically explore what are the determinants that drive access to credit and input advances from brokers to farmers, we use a Heckman model where we estimate in a first stage the likelihood that a farmer was a beneficiary of a loan for personal needs in the last five years and of input advances in the last season, and then estimate in a second stage how much he received. The distance from the farmer to the wholesale market serves as an instrument in the selection equation.[23] The results are shown in Table 6.

The selection into interlinked credit relations is seemingly little linked with poverty levels, as poorer farmers have equal access to loans as richer ones (as measured by total land cultivated, by having access to a BPL card, or by being member of a scheduled or backward caste/tribe). Farmers that live further from the market are significantly less likely to receive a loan (or input advances). Using the distance to markets as instrument, the selection bias is reported to be insignificant by the likelihood ratio test at the bottom of Table 6. This means that we may as well consider the OLS estimation of the determinants of the size of the loans/input advances as valid (and moreover preferred to the second-stage Heckman regression results, as the OLS estimation is more efficient). The OLS results are thus also presented in Table 6.

Farmers who cultivate more land of the vegetable under study, receive significantly larger loans. A doubling of the area increases the size of loans for personal needs as well as of input advances by around 50%. This confirms earlier results of Bell and Srinivasan (1989)

[22] As the credit use variable is a function of factors that determine both the willingness of the broker to supply credit and the demand for credit by the farmer, there is no clear argument on how poverty levels would influence credit use and the sign of its coefficient could go either way. For example, poor farmers may ask more (or more often) credit as they are more capital constrained while rich farmers may ask more (or more often) credit as they generally use more capital-intensive cultivation methods. On the supply side, rich farmers may be offered more (or more often) credit as they have better capacity to repay, or give a more assured return to investment, while poor farmers may be offered more (or more often) credit if they are seen as an easy target for rent extraction (which is the result that would alarm us). For a detailed discussion on credit use and the poor in developing countries, see e.g. Zeller and Sharma (1998).

[23] Distance to the wholesale market should be a determinant of the costs of recuperating the money in case of default but conditional on receiving a loan, it can be argued that it should not affect the amount of the loan.

where they found credit-marketing linkages in India to be stronger in the states where larger farmers dominate.[24]

These findings seem to indicate that brokers provide financial services in a rational way and that they do not discriminate in favor of or against the poor or specific castes. Brokers are more likely to provide loans or advances to those farmers whom are easier to monitor (as measured by travel time from the farmer's village to the market) and to provide larger loans or advances to farmers who have a larger trade volume on which the broker can earn his margin (as measured by the area allocated to the crop traded).

(b) Interest rates

As shown in Table 5, usually no interest rates are charged on interlinked input advances. While 11% of the surveyed farmers received input advances, less than one out of five are charged interest on these.[25] Hence, in line with the traditional literature on interlinking (Bell, 1988; Basu, 1986), brokers do seem to subsidize capital costs for farmers.

(c) Output prices

With our data, we do not find evidence of exploitative interlinkages as reported in other settings. While advances have to be paid back from sales revenues, interlinkage does not seem to lead to lower implicit product prices. To empirically test this hypothesis, we link the product prices with a dummy on the use of input advances or loans for personal needs in the last five years. We run an OLS regression, in which we control for the type of product and the quantity transacted, the day and location of trade, a range of observable quality attributes of the product, and a set of household characteristics which could possibly also play a role in price determination (for example through bargaining power). Further, given potential endogeneity concerns, we also run a 2SLS instrumental variable regression where we instrument the use of credit or input advances by the logarithm of the time needed for the farmer to travel to the market; and a treatment effects regression where we use travel time to the market, product type, market location and some household characteristics to predict treatment (Table 7).

[24] Crow and Murshid (1994) find in Bangladesh that social power is an important determinant of access to loans and that poorer households get loans but on less advantageous conditions.

[25] Unfortunately, the corresponding figures for practiced interest rates on loans are lacking; as input advances loans and are of similar sizes, one could possibly expect similar patterns for these. This is left for future research.

The first stage regression of the IV estimation shows, as expected, that a further distance from the market is associated with lower credit or input advance use. The value of the F-test is significant at the 10% level but is below 10, indicating a problem of weak instruments. Given the presence of weak instruments, we apply the Anderson-Rubin test (Mikusheva and Poi, 2006). This procedure corrects the threshold value for the significance of the variable of interest allowing for weak instruments (Bottom Table 7).

Controlling for endogeneity raises the coefficient on the endogenous variable, suggesting that our OLS estimation was underestimating the impact of receiving credit on producer prices. This could for example be caused by a feedback from product prices onto the demand for credit, in particular the fact that farmers who receive lower prices, need credit more often.

All specifications (OLS, IV and Treatreg) show there is no significant negative link between the use of credit and prices received by the farmer, implying that there is no evidence that interlinkage leads to lower prices for the farmer. In fact, the reverse even seems to be true: from the OLS and the treatment regression it seems that market interlinkages coincide with better pricing conditions for farmers. The endogenous variable carries the same sign in the IV regression, but it is not significant due to the lower level of efficiency in the latter. A potential explanation rests in the fact that credit could be a proxy for trust or loyalty, which may have a positive impact on prices as well. If this is true, provision of financial services could be interpreted as a strategy for non-price competition, rather than an instrument for exploitation.

Brokers thus seem to use these interlinkages to tie farmers to them and increase their turnover. They seem to have enough rents under the existing regulated market system to pay for the cost of the financial services they provide. These rents may arise from market regulations leading to restricted trader entry and pervasive collusion (e.g. Goyal, 2010), or from advantages these brokers enjoy in terms of access to credit and/or input markets - in line with the argument made by Bardhan *et al.* (2009).[26] Another possible source of broker rents reported by Goyal (2010) is the informational advantage on market and price conditions brokers enjoy as compared to the sellers and buyers they interact with.

[26] Almost half of the farmers in our survey who received input advances in the form of seeds, reported that they would not be able to find the same quality of seeds themselves at the same price. On the other hand, they do not believe that productivity of their vegetables was higher because of the use of these inputs.

To better understand these interlinkages, we further asked farmers what the broker would do if the farmer would not pay back the loan received. As is usually the case in this type of markets, a formal enforcement mechanism is little relied upon (e.g. Fafchamps and Minten, 2002; McMillan and Woodruff, 1999; Swinnen and Gow, 2001). Farmers report that it is very unlikely that the broker will go to the market authorities, to the police, or to court (see Table 5). The broker will however refuse to work with defaulting farmers in the future, he might inform other brokers about it, and some brokers might use peer pressure in the village to enforce repayment.

7. Conclusions and implications

Relying on primary micro-level data, we study the wholesale market activities of agricultural brokers in India. Our results show that market regulations are significantly different from effective practices on the wholesale markets under study. For example, most brokers charge rates that significantly exceed the prescribed ones. This is an important finding to feed into the ongoing debate on the importance of existing market regulations which seem to impede the development of modern market channels. For example, regulations in many states prohibit direct purchases from the farmer beyond the regulated market system and there are severe restrictions on foreign direct investment in modern retail.

As brokers further seem to be able to capture rents under current market regulations, it can be expected that the removal of these regulations to allow for free entry in primary marketing of agricultural produce offers scope to increase competition, and, consequently, raise farm prices and incentives for increased productivity. One recent example of how increased competition in these settings can raise farm prices is shown in the case of soybean prices in Madhya Pradesh, which significantly increased after the introduction of internet-based kiosks providing farmers with price information and an alternative marketing channel (Goyal, 2010).

One often-heard critique on market deregulation is that it may lead to market power. However, it seems that given options and information, and given the often large number of players on food markets in Asia, the likelihood of monopsonistic or oligopolistic market structures arising seems to be rather low in these markets. For example, a number of studies have shown the competitive nature of agricultural markets in Asia when unregulated (e.g. Chowdhury and Haggblade, 2000; Wang *et al.*, 2009; Barker *et al.*, 1985; Hayami *et al.*, 1999). In developed countries, companies in the food sector tend to undergo a certain degree

of consolidation and concentration, often for efficiency reasons, which might lead to market structure concerns. However, it seems that India still has a long way to go to reach that stage. Moreover, there is a lack of convincing empirical evidence to support the argument that this would really hurt suppliers of agricultural products (see e.g. Swinnen and Vandeplas, 2010).

Our results also show that some brokers tie farmers to them through linkages in credit and insurance markets. We find, consistent with previous literature on interlinkages (Bell, 1988; Basu, 1986), that brokers subsidize interest rates on advances but in contrast with this literature, we do not find that this leads to lower implicit output prices for farmers using these financial services. Interlinkages do not seem to be an instrument for farmer exploitation, but rather a service by brokers to establish farmer loyalty and ensure future supplies. Brokers seem to have enough rents under the existing regulated market system − possibly because of their overcharging − to pay for the cost of the financial services they provide.

It is interesting to find these linkages in traditional markets, as they seem congruent with the tendency towards more vertical coordination in modern supply chains, once food safety and quality requirements become critical benchmarks. In modern supply chains, companies often contract with suppliers and provide inputs, possibly on credit, as to assure quality. However, it seems that in traditional markets the incentive for brokers to establish interlinkages with farmers is different; as their objective seems to be tying the output of farmers to them in order to increase their turnover (Crow and Murshid, 1994; Bell and Srinivasan, 1989; Bell, 1990) with little regard for food safety, monitoring of production practices, distribution of quality inputs, or extension of improved technologies, which are typical for modern markets (Swinnen, 2007).

This implies that for some of the farmers there could be both benefits and costs of deregulation of agricultural markets. While all would benefit from getting better prices, some may lose access to the benefits of interlinkages and of subsidized advances. In the case that input advances would still be given in a deregulated and more competitive environment, farmers that use them would have to pay the real costs for these, showing up in higher interest rates or lower implicit output prices.[27] However, it seems that only a minority of the farmers would be affected by this (as in our survey, just over 20% of the farmers reported to have

[27] The spillover effects of output market liberalization on reduced access to inputs was a major issue in the liberalization of agriculture in Eastern Europe and the former Soviet Union (Rozelle and Swinnen, 2004) as well as in some African countries (Swinnen *et al.*, 2011).

received loans or advances). The vast majority of the farmers (almost 80%) would not be affected by this and only benefit from the positive price effects of market deregulation.

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Tables

Table 1: Descriptive statistics

		Unit	Farmers		Retailers	
			Avg or %	St. Dev.	Avg or %	St. Dev.
Demographics						
Age		years	47.2	10.4	37.3	9.8
Level of education		years	5.3	4.1	4.8	3.4
Household size		number	8.0	3.0	7.0	2.3
Member of scheduled or backward caste/tribe		%	37		39	
Wealth						
Has a BPL (Below the Poverty Line) card		%	29		30	
Has an APL (Above the Poverty Line) card		%	65		51	
Own mobile phone		%	47		25	
Land owned		begha (≈ 1/15 ha)	19.0	23.0		
Own tractor		%	29			
Own cattle		%	88			
Product characteristics (cauliflower, green peas)						
Average sales	both products	kg per day			36.2	31.7
	cauliflower	kg per day			28.3	16.1
	green peas	kg per day			44.2	40.3
Average production	both products	tons per season	15.4	18.1		
	cauliflower	tons per season	25.4	18.9		
	green peas	tons per season	5.5	10.0		
Sell other products	both products	% yes			85	
Importance in monetary income	both products	avg %	75.2	23.9	41.3	30.3
Experience with…	both products	years	12.6	10.9	11.6	8.3
Land cultivated of…	both products	begha (≈ 1/15 ha)	21.5	23.5		
	cauliflower	begha (≈ 1/15 ha)	23.1	20.8		
	green peas	begha (≈ 1/15 ha)	20.0	25.9		
Marketing behavior						
Distance to wholesale market		km	42.1	34.8	3.5	2.1
Visits on this market		visits last 2 weeks			10.0	3.4
		visits this year	23.5	18.7		
Time spent on the market		hours	3.5	2.2	2.3	1.0
Visit of other mandi		%	16		2	

Source: Authors' own survey.

Table 2: Quality and quantity assessments

		Quality		Quantity	
	Unit	Farmers	Retailers	Farmers	Retailers
Overall					
There are quality/quantity differences between lots					
A lot	%	1	3	1	3
A bit	%	93	92	94	90
None	%	6	5	5	6
It happens that farmer/retailer receives/delivers lower quality/quantity than paid for					
Regularly	%	0	0	0	0
Sometimes	%	25	68	19	62
Never	%	74	32	80	38
It happens that farmer/retailer receives/delivers higher quality/quantity than paid for					
Regularly	%	5	3	5	3
Sometimes	%	68	52	64	29
Never	%	27	45	31	58
Last transaction					
Retailer had enough information before transaction	% yes		83		78
Quality assessment last transaction					
The retailer checked quality himself	% yes		85		
If not,…					
… how was quality assured?					
No assurance on quality	%		66		
Assurance is based on trust with broker	%		34		
If yes, …					
… way of quality checking					
by looks	%		100		
by touch	%		62		
by smell	%		7		
by taste	%		34		
… retailer was able to check whole lot	% yes		34		
… if only part of the lot, was it representative?	% yes		90		
The retailer knows about production activities					
(i.e. pesticide use, irrigation water use, etc.)	% yes		22		
Quantity assessment last transaction					
Farmer/retailer knows exact weight of the lot	%			80	73
If weighed, …					
..., weighed in front of farmer/retailer?	%			80	93
type of scale used is					
… mechanical	%			67	73
… electronical	%			33	27
rounding off weights	%			88	86
rounding off weight in farmer's advantage	%			16	11
rounding off weight in retailer's advantage	%			84	89
If not weighed,…					
…, differences between standard units?					
A lot of variation	%			0	8
A bit of variation	%			88	83
No differences	%			12	8
Retailer knows quantity of wastage at purchase					
Exactly	%				9
Approximately	%				57
Not very well	%				34

Source: Authors' own survey

Table 3: Determinants of vegetable prices (dep. var. = log(price per kg))

		Cauliflower				Green peas			
		Model 1		Model 2		Model 1		Model 2	
	Unit	Coeff	t-value	Coeff	t-value	Coeff	t-value	Coeff	t-value
retailer	1=yes	0.26 ***	9.23	0.24 ***	8.41	0.13 ***	4.12	0.13 ***	4.40
Dehradun market	1=yes	0.28 ***	9.91	0.31 ***	8.26	-0.41 ***	-13.10	-0.47 ***	-15.11
medium size	1=yes			-0.13 ***	-3.77				
small size	1=yes			-0.27 ***	-4.35				
mixed size	1=yes			-0.12 **	-2.79				
number of peas per shell	number							-0.02	-2.08
presence of spots	1=yes			0.07 *	1.97			-0.02	-0.47
rotten material	1=yes			0.05	1.34			-0.13 ***	-2.75
less bright color	1=yes			0.03	0.68			-0.10 **	-2.50
day of transaction included		NO		YES		NO		YES	
intercept		1.30 ***	53.31	1.71 ***	15.78	2.35 ***	109.27	2.51 ***	24.79
Number of observations		240		239		240		236	
F-statistic		92.40		18.86		87.85		69.66	
Prob > F		0.00		0.00		0.00		0.00	
R-squared		0.44		0.61		0.44		0.62	
F-test for price difference between farmer and retailer higher than prescribed 5.5%									
F-value		53.37 ***		42.43 ***		5.48 **		6.29 **	
Prob>F		0.00		0.00		0.02		0.01	

Note: Significance level is expressed as *** for p<0.01, ** for p<0.05 and * for p<0.1

Source: Authors' own survey

Table 4: Frequencies of transactions and reasons for the choice of a broker

	Unit	Farmers		Retailers	
		Avg or %	St. Dev.	Avg or %	St. Dev.
Frequencies of transactions					
Number of transactions through brokers					
this season	number	9.6	9.7		
last year	number	26.1	27.2		
last two weeks	number			9.0	2.7
Number of brokers used for these transactions					
this season	number	1.6	0.9		
last year	number	1.8	1.2		
last two weeks	number			3.5	2.6
Number of brokers used last season (farmers)/last 2 weeks (retailers)					
One	%	57		17	
Two	%	33		19	
more than two	%	10		64	
Time dealt with the broker of last transaction	years	9.7	9.1	9.2	7.1
% that states this as a "very important" reasons for choosing the broker in the last transaction					
"He finds lots of potential buyers/sellers"	%	46		34	
"He offers better prices"	%	55		64	
"He offers higher quality"	%			66	
"He gives seasonal input advances"	%	26			
"He allows me to defer payment"	%			16	
"He offers loans in case of need"	%	21		4	
"I have the habit"	%	50		29	
"He has quick transactions"	%	63		58	

Source: Authors' own survey

Table 5: Credit and input advances

	Unit	Farmers		Retailers	
		Avg or %	St. Dev.	Avg or %	St. Dev.
Access to credit/insurance (from broker in last transaction)					
The broker gives loans in case of need					
yes, for sure	%	39		7	
probably	%	18		22	
no	%	44		71	
Buyer/seller ever received a loan from this broker	%	22		2	
Number of loans received in the last five years [1]	Number	1.9	1.1	2.4	1.7
The value of the loan - mean	Rs	8263	9429	21500	38464
Buyer/seller has other sources of loans	% yes	96		95	
If yes, from…					
...bank	%	46		17	
…friends/family	%	78		81	
…others	%	2		14	
Access to input advances (from broker in last transaction)					
Received an input advance this season from broker in last transaction	%	21			
(Partly) in kind (seeds)	%	12			
Value of seeds received - mean	Rs	6115	7769		
(Partly) in cash	%	12			
Amount of cash received - mean	Rs	6982	9546		
Had to pay interest on these advances	%	4			
Receives advances every year	%	6			
What would happen if these input advances were not paid back? [2]					
"Broker will not work with me anymore"	% yes	84			
"Broker would complain to the market authorities"	% yes	20			
"Broker would complain to the other brokers"	% yes	77			
"Broker would use social pressure in the village"	% yes	55			
"Broker would bring me to the police or court"	% yes	2			

[1] for those who ever received a loan; [2] for those who received input advances

Table 6: Determinants of loans and input advances received by farmers

		Log(inputs)				Log(loans)			
		OLS		Heckman		OLS		Heckman	
		Coeff	t-value	Coeff	t-value	Coeff	t-value	Coeff	t-value
Determinants of log(Amount in Rs)									
household characteristics									
member of SC/ST/OBC	yes=1	-0.13	-0.31	-0.17	-0.46	-0.66 *	-1.69	-0.53	-1.10
years of education	log(number)	-0.07	-0.49	-0.15	-0.88	-0.13	-0.44	-0.30	-0.71
holder of BPL card	yes=1	0.22	0.72	0.22	0.73	0.33	1.08	0.32	1.03
household size	yes=1	-0.07 **	-2.33	-0.06	-1.75	0.02	0.30	0.01	0.19
production characteristics									
cauliflower	yes=1	-0.18	-0.17	-0.52	-0.37	-1.07	-0.91	-0.73	-0.55
area cultivated of cauliflower	log(area)	0.26	0.73	0.31	0.81	0.82 **	2.39	0.75 *	2.09
area cultivated of green peas	log(area)	0.50 **	2.04	0.46 *	1.58	0.55 **	2.53	0.57 **	2.79
market characteristics									
market of dehradun	yes=1	0.60 *	1.64	0.63	1.52	-0.08	-0.18	0.04	0.08
intercept		8.02 ***	15.37	7.58 ***	6.83	7.94 ***	7.62	8.68 ***	5.42
Selection equation									
household characteristics									
member of SC/ST/OBC	yes=1			0.00	-0.01			-0.15	-0.56
years of education	log(number)			-0.03	-0.25			0.55 ***	3.23
holder of BPL card	log(number)			0.34	1.35			0.32	1.24
household size	yes=1			0.03	0.94			0.03	0.78
production characteristics									
cauliflower	yes=1			-0.71	-1.16			-0.83	-1.29
area cultivated of cauliflower	log(area)			0.21	1.04			0.23	1.13
area cultivated of green peas	log(area)			0.02	0.13			-0.01	-0.06
market characteristics									
market of dehradun	yes=1			0.04	0.15			-0.40	-1.57
distance to the market	log(hours+1)			-0.80 ***	-2.73			-0.53 **	-1.83
number of visits per year	log(number)			0.16	1.10			-0.15	-0.88
intercept				0.20	0.30			-0.46	-0.62
Nr. of observations		47		237		52		237	
R-squared		0.39				0.28			
Wald chi2(8)				30.59				25.67	
Prob > chi2				0.00				0.00	
LR test of independent equations (rho=0)			Chi²(1)	0.29			Chi²(1)	0.39	
			P-value	0.59			P-value	0.53	

Note: Regression results robust to heteroscedasticity. Significance level is expressed as *** for p<0.01, ** for p<0.05 and * for p<0.1
Source: Authors' own survey

Table 7: Effect of interlinkage on prices paid to farmers (dep. var = log(price per kg))

		OLS		IV		Treatreg	
	Unit	Coeff	t-value	Coeff	t-value	Coeff	t-value
credit/input advances	yes=1	0.09 ***	2.75	0.55	1.54	0.42 ***	2.67
cauliflower	yes=1	-1.41 ***	-5.73	-1.60 ***	-3.79	-1.28 ***	-5.09
Dehradun market	yes=1	-0.14 ***	-2.89	-0.14 **	-2.06	-0.14 **	-2.48
cauliflower							
quantity sold	log(kg)	0.02	0.77	0.05	1.02	0.02	0.79
medium size	yes=1	0.05	0.88	0.10	1.12	0.01	0.22
small size	yes=1	-0.12	-1.10	-0.14	-1.04	-0.16	-1.43
mixed size	yes=1	-0.14 *	-1.80	-0.16 *	-1.78	-0.20 **	-2.54
presence of spots	yes=1	0.20 ***	2.75	0.13	1.37	0.18 ***	2.71
rotten material	yes=1	0.04	0.56	0.01	0.08	0.05	0.64
less bright color	yes=1	0.21 **	2.40	0.23 **	2.54	0.19 **	1.96
green peas							
quantity sold	log(kg)	-0.09 ***	-2.79	-0.09 **	-2.20	-0.08 ***	-2.81
number of peas per shell		-0.02	-1.27	0.00	0.00	-0.02	-1.25
presence of spots	yes=1	0.07	1.25	-0.04	-0.29	0.07	1.27
rotten material	yes=1	-0.20 **	-2.16	-0.19 *	-1.68	-0.20 **	-2.34
less bright color	yes=1	0.01	0.10	-0.21	-1.02	-0.01	-0.17
Household characteristics							
member of SC/ST/OBC	yes=1	-0.09 **	-2.06	-0.06	-1.05	-0.09 *	-1.82
years of education	log(nr)	0.05 **	2.40	0.02	0.60	0.02	0.81
holder of BPL card	yes=1	0.00	0.14	-0.03	-0.47	-0.02	-0.54
day of transaction included		YES		YES		YES	
intercept		3.21 ***	16.31	3.00 ***	7.90	3.12 ***	15.70
Number of observations		239		237		237	
F(26, 212)		49.91		15.52			
Prob > F		0.00		0.00			
Wald chi2(26)						1026.17	
Prob > chi2						0.000	
R-squared		0.77		0.60			
Adj R-squared				0.55			
AIC		-2.34				270.56	
BIC		91.53				395.41	
For IV regression:							
First-stage regression statistics				F(1,215)	3.750		
P-value for significance instrument: log(distance traveled)				Prob>F	0.054		
P-value Wu-Hausman F-test for exogeneity of end. var				Prob>F	0.086		
P-value Durbin-Wu-Hausman-test for exogeneity of end. var.				Prob>Chi	0.069		
P-value A-R test for signif. end. var. with weak instrument (cov.-corr. conf. set)					0.042		
For Treatment Effects (ML) regression:							
P-value Wald-test of independent equations:				Prob>Chi	0.004		

Note: The selection equation of the treatment regression controls for logarithm of time required to travel to market (which functions as the excluded instrument in the IV regression), for product and market, and for same household characteristics as above.
Note: Results for regressions (1) and (3) are robust to heteroscedasticity; Results for regression (2) are robust to weak instruments.
Significance level is expressed as *** for p<0.01, ** for p<0.05 and * for p<0.1.
Source: Authors' own survey

Figures

Figure 1: Cauliflower prices

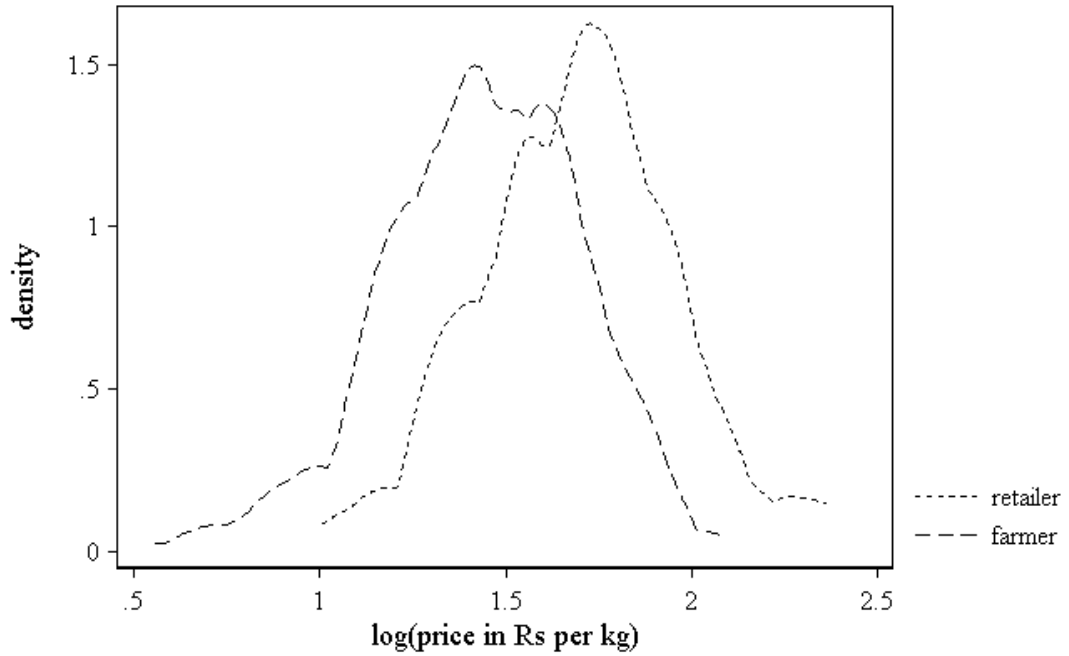
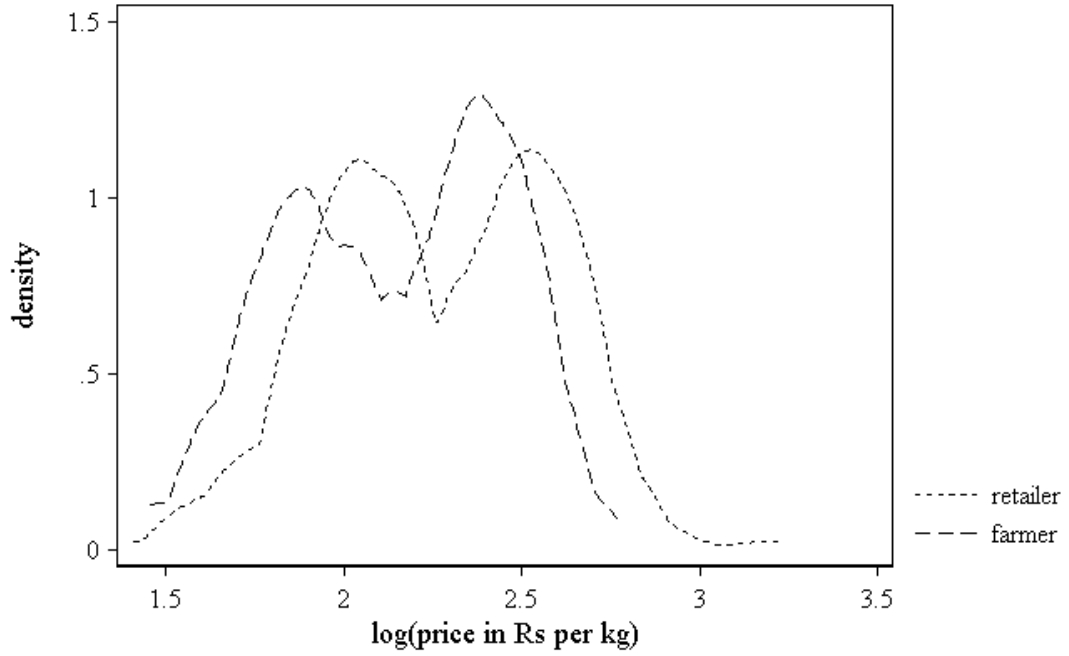


Figure 2: Green pea prices



Source: Authors' own survey.